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Exhibit 6
Austin Test Report

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I. Introduction

Background

On July 8, 1997, Diversified Communication Engineering, Inc. (DCE) was granted by the FCC an experimental license, call sign WA2XMY, to conduct tests in a rural environment in Kingsville, TX, to investigate and validate the Northpoint technology and its compatibility with the Direct Broadcast Satellite (DBS) service. On July 20, 1998, an extension of the original experimental license was granted to continue to test in Kingsville, as well as to perform tests in an urban environment in Austin, TX.

The Northpoint (NP) technology[1] concept provides a means to broadcast terrestrial signals for a local market in the presence of, and co-frequency with, DBS signals, without interfering with either service. The concept for co-existence of the two services is partially based on the high degree of spatial selectivity of the DBS receiving antennas as well as other factors incorporated into the NP technology concept.

Current Testing Builds on Successful Work in 1997

Initial field tests of the Northpoint technology were conducted in 1997 on the King Ranch near Kingsville, Texas, as described in the previous Progress Report – WA2XMY, Submitted on January 8, 1998[2]. The main purpose of that initial field test was to verify the basic Northpoint concept and to establish an appropriate NP transmitter power level for optimal coverage of a reasonable service area cell, while producing minimal or zero interference to the DBS service in the immediate vicinity of the transmitter. This small region near the transmitter is known as a 'Mitigation Zone' and is defined as the area in which special mitigation measures might be needed to avoid interference with DBS users within the zone. The King Ranch tests served to confirm the theoretical expectation of NP-DBS compatibility.

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[1] US Patents No. 5,483,663 (9 Jan 1996) and No. 5,761,605 (2 Jun. 1998) – by Saleem Tawil and Carmen Tawil of DCE, Austin, TX.

[2] Experimental Testing Report – 1997 Kingsville Tests, 'Progress Report – KA2XMY', Submitted by DCE, Inc., On Behalf of Northpoint Technology, to FCC Experimental Licensing Branch, Jan. 8, 1998.

Urban Area Testing Demonstrates Practicality of System

Field tests were conducted in Austin, TX, during December 1998. The Northpoint terrestrial transmitter (NP-Tx) was located on the DCE headquarters building in downtown Austin. The test area contained a variety of environmental conditions, ranging from high-rise buildings in the downtown area to residential neighborhoods with varied terrain and foliation. Weather conditions during testing also were varied, ranging from clear sky to severe rain, providing the fortunate opportunity to gather test data under adverse conditions.

The work done in this phase of our experimental work has greatly expanded our field knowledge of the workings of the Northpoint system and demonstrated that the system works well in an urban area. With this test we have documented that multi-pathing, an issue previously raised as a concern, is not a problem for the Northpoint system. Furthermore, we have demonstrated that under line-of-site conditions, a good quality Northpoint signal could be obtained at almost 14 miles, which would equate to a service area of 190 square miles.

Also of special note during this test was the fact that no beam-tilting or other mitigation techniques were required to achieve the positive results report herein.

Test Goals

Test objectives included the following, among others:

(a) To observe the DBS satellite signals DirecTV (DTV) and Echostar (ES) and the Northpoint (NP) signal at several sites and various site conditions within the test service area, to determine the signal strengths and to assess the presence and extent of any Northpoint interference into the DBS signals. To include test sites which appear to present extreme or worst case interference conditions;

(b) To examine the nature and extent of the Mitigation Zone for this test environment and to consider some effective remedies if required;

(c) To investigate effects of multi-path propagation due to reflections from buildings and other structures that are prevalent in certain portions of the test area;

(d) To explore the service area range for this test environment, with a sampling of intermediate and far-range measurement sites, and to observe effects of terrain and foliage;

(e) To examine the nature of the Northpoint signal in regions outside of the main NP-Tx antenna beam, to the side and to the north of the antenna;

propagation and interference mechanisms, as deemed necessary and feasible. Such tests included experiments to determine various DBS channel programming parameters needed for the test work; and signal reflection and shielding experiments.

Detailed Test Plan Prepared with DBS Industry Input

The tests were conducted in general accordance with the NP-DBS Compatibility Testing Plan – Phase I Draft[3], with the exception of a few minor procedural changes. This Test Plan was provided on request to both DirecTV and United States Satellite Broadcasting (USSB), whose input was incorporated into the final draft.

Public notice of the field work, test period and contact information were published by DCE in the local newspaper, with copies sent to all DBS licensees via certified mail, as required, prior to start of the project. The field work was done during the calendar period from the 4th through the 31st of December 1998. During the first portion of this period, considerable effort was devoted to equipment calibration and general procedure refinements, and to special experiments related to all aspects of the test objectives. These experiments included reception and assessment of the DBS satellite signals in the presence of the NP transmissions; reflection and multi-path tests; tests with signal obstructions; and tests of intermediate and far range reception of the NP signals. Interference tests focused initially on sites in the Mitigation Zone and at predicted maximum interference regions for the DirecTV and Echostar satellites as determined by the DeLawder study[4], where conditions of signal strengths and antenna pointing directions are most favorable to interference by the NP signal.

Error Rate Testing Done with Consumer Set Top Box to Assess Real World Impact

All parties interested in these tests have desired the use of means to assess the degree of DBS interference in a quantitative manner by measurement of the signal error rate or an equivalent parameter. However, certain proprietary information and special hardware needed to make an actual error rate measurement has not yet been made available to NP from the DBS service suppliers. During this initial test period, an alternate error assessment was first suggested by USSB personnel, based on the DBS software 'signal strength pointer' (ssp) that is provided for use in peaking the DBS antenna. Such a approach, to be described later, was implemented based on information from DirecTV personnel on the general nature of the relationship of this ssp feature to error rate and based on some related field experiments. This work is quite valuable because it provides a basis for determining what impact, if any, NP's operations will actually have on consumers

[3] Northpoint Technology – 'DBS Compatibility Experimental Testing Plan – Phase I Draft', Submitted by Diversified Communication Engineering, Inc., On Behalf of Northpoint Technology, Nov. 5, 1998.

[4] DeLawder Communications , Inc., Engineering Report, 'Austin Testing Technical Annexes', Submitted by DCE, Inc., On Behalf of Northpoint Technology, to the FCC, June, 1998.

a basis for determining what impact, if any, NP's operations will actually have on consumers under real world conditions.

Back up Equipment Used to Ensure Data Integrity

On December 18th it was noted that the HP8563E Spectrum Analyzer that was then in use was no longer functioning properly in the L-band range. At this point, two new spectrum analyzers were deployed, including an HP8563E and HP8591E (See equipment descriptions in Section III). After re-calibration of the system, the final field measurements were made during the period of the 22nd to the 31st of December 1998, and all sites were tested and recorded during this time.

The following sections of this report discuss the equipment, procedures, special tests, results, and the conclusions in some detail. The measurement site locations are shown on site maps and on aerial photographs, and other figures present the measured results. The Appendix contains supporting information in the form of the NP transmitter log, receiver site logs, and calibration notes.

Testing Team

The field work for this project was conducted by Dr. Darrell R. Word, P.E., of D. R. Word Associates (DRW), Leander, TX, with the assistance of four senior electrical engineering students from The University of Texas at Austin, working as interns. The intern staff is as follows: Mark Edge, Michael Harper, Jennifer Bernard, and John Dean. The report preparation was done by D. R. Word, with the help of Mark Edge and Michael Harper. Carmen Tawil, P.E., and Saleem Tawil, P.E., of DCE and NP, and Sophia Collier and Chula Reynolds of NP have provided help and support throughout all facets of this project.

II. Summary of Tests and Results

Northpoint System Did Not Cause Harmful Interference to DBS Receivers

This section is meant to provide an overview of the tests conducted and of the results in general terms. The test conditions are described in Section III, and further discussions of the tests, results, and conclusions are presented in Sections IV, and V, to follow.

The NP transmitter was operated as described in the introduction and Section III, a total of 30 measurement sites were tested, over a wide range of distance and azimuth from the

NP transmitter site, and for a wide variety of conditions related to signal paths and likelihood of NP-DBS interference. The Site Maps of Figures II-1 and II-2 show the receiver site positions as red dots and the NP transmitter as a green cross. Figure II-1 is scaled to show all 30 sites of the survey, while Figure II-2 shows an enlarged view of the sites in the area near the transmitter.

The NP transmitter is located at Congress Ave. and 1st Street, just north of the Colorado River and is designated NP-Tx. The receiver sites have assigned site numbers that are used for reference in the site logs and throughout this report. Site numbers for sites clustered near the transmitter are omitted on the 'Far Range Scale' map but can be viewed on the 'Near Range Scale' map. Numerical site position parameters are given in the table of Figure IV-3, which shows the transmitter and receiver site coordinates. Polar position is also given as the range and azimuth of the receiver site from the transmitter site. As evidenced by this table, the receiver test sites range in radial distance from 0.36 miles to over 13.8 miles, over a wide range of azimuth angle.

Routine measurements were made at all sites to determine the DBS and NP signal strengths and signal integrity, and to assess the possible NP to DBS interference. However, beyond these routine observations, the site placements are related to several specific test objectives. The close range sites are primarily related to various interference issues including multi-pathing, while the intermediate and far range sites are more related to NP signal reception issues and assessment of service area range. Of the close range sites just south of the river, some of them (sites 3,7,8, and 4,10) are located in or near the theoretical 'maximum interference regions' for DirecTV and Echostar DBS systems, respectively; and sites along Barton Springs Road, as well as sites 4, 10, and 20, were selected for reflection and multi-path tests, with nearby large buildings to the south serving as reflectors. Sites to the NW of the transmitter, placed among large buildings of downtown Austin, were chosen to examine the interference potentials, in addition to the assessment of NP signal reception in that direction. For the NW sites, an added possibility for interference into the DBS system was possible because of NP signal propagation toward the front side of the DBS antennas. Some locations, including sites 11 and 12, were chosen because they are in heavily wooded areas and can affect NP reception due to tree obstructions.

During the course of the tests, there were also a wide variety of weather conditions, as shown in the table of Figure IV-4, with skies ranging from clear to heavy overcast and rain.

In all cases of site conditions and test objectives, and for all sites, the results were favorable to the Northpoint technology. TV signal reception was achieved for both DBS signals and for the NP signal, and there was no user-detectable DBS interference at any site of the survey. There was no known interference in the Mitigation Zone. An expected small influence on the DBS error rate was observed, as indicated by the DBS signal strength pointer scheme, for sites located in the 'maximum interference' zones and where conditions would otherwise suggest that there should be an influence. However, the effect on the indicated signal error rate was apparently minor, and there is no significant indication of DBS error influence outside the immediate vicinity of the NP transmitter.

NP signal reception was found to be viable at distances up to almost 14 miles, under line-of-site conditions. In general, the NP signal was found to be viable when a line-of-site was available, even through trees and other obstructions. In heavily wooded areas, it was found that the NP receiving antenna could usually be moved a few feet one way or the other to find a position for viable reception.

In short, the results of the tests appear to confirm theoretical expectations and represent a favorable indication for viability of the Northpoint technology.

III. Test Conditions

A. Equipment

Figures III-1, III-2, and III-3 show block diagrams of the main instrument systems for this test project. This section will describe the essentials of the equipment and the implementations used.

Transmission Equipment (Figure III-1)

The NP transmitter system (NP-Tx) is comprised of the following components:

a. Transmitter unit – LNR Communications, Inc. model DVE-Ku-1 s/n 164.
1 Watt transmitter w/ digital encoder, QPSK modulation and
Power Level Control – Items (30, 31, 32, 33).

b. Seavy Engineering custom horn antenna w/ 10 dB gain, horizontal polarization, 110 degree horizontal beam width and 17 degree vertical beam width – Item (35).

c. Andrew EW127 wave guide (70 ft) with WR-75 flanges – 2.5 dB loss – Item (34).

d. Video Camera to supply a test video signal to the encoder – Item (40).

As shown in the diagram, for calibration of the transmitter output power, a flange adapter (36) and 20 dB attenuator assembly is attached to the waveguide output in place of the antenna. For the approximately 5 dBm of output power that is used, the output power to the transmitter antenna can be monitored directly with the HP power meter and sensor during the calibration adjustment.

Test Set System (Figure III-2)

Figure III-2 represents the precision measurement equipment used for calibration of the NP Transmitter and the DBS Receiver System. The assembly was comprised of the precision horn antenna (8), the LNA (5), and the associated cables (9 and 10), which operate in the Ku-band, and was pre-calibrated as described in Appendix 2 and then used as a calibration standard for the receiver system. The Synthesizer (6) and Power Meter (7) were used as auxiliary general purpose instruments for calibration of cables and other system components, as well as for the NP transmitter calibration. The HP8563E Spectrum Analyzer (SA), Item (1), was used to measure the TS System output signal power Po, and the Printer (3) was provided to make SA screen copies.

The TS System is further described below:

a. Precision Horn (8) – Scientific Atlanta SA-12-12 s/n 340
w/ Narda 4609 flange to SMA(F) coax adapter
Beam width: 9 degrees in H-plane /
10 degrees in E-plane
Operating Frequency: 12.4 – 18 GHz.
Measured Gain over Isotropic: 24.0 dB.

b. LNA (5) -- JCA Technology, Inc. JCA1218-F01
Operating Frequency: 12.0 – 18.0 GHz.
Measured Gain: 25 dB.

c. Cable (9) -- HP11500F – SMA(M) – (50 ohm) -- 6 ft. long.
Measured Gain (Loss): - 1 dB.

d. Cable (10) -- Andrew EFX2-50 – SMA(M) – (50 ohm) – 40 ft. long.
Measured Gain (Loss): - 6 dB.

e. Spectrum Analyzer (1) -- HP8563E w/ HPIB control I/O.

f. Printer (3) -- HP Think-Jet w/ HPIB port and cable.

g. Synthesizer (6) -- HP83732B.

h. Power Meter (7) – HP5347A w/ HP8481 Sensor and Cable.

Note: For the calibrated TS System parameters, the gain of the system from the antenna input to the Po signal (at the SA) can be expressed as: 'Gain over Isotropic' = +42 dB.

Receivers (Figure III-3)

This receiver system was used to observe and measure the DBS satellite signals and the NP signal at each test site. The antenna is a standard RCA DBS antenna with an LNB down-block converter that outputs an L-band IF signal for use by the integrated Rx/Decoder (IRD) unit. The LNB output is passed through splitter (24), in order to provide signals to both the Spectrum Analyzer (25) and the IRD at the same time. The one antenna is shared with three separate IRDs, one for each of DirecTV, Echostar, and Northpoint, respectively. The TV monitor (19) is also shared among the three IRDs. The IRDs are interchanged by manually switching cables, while the signal path from the LNB to the spectrum analyzer remains fixed.

The HP8591E (25) is an L-band spectrum analyzer with a 75 ohm input impedance, to match the LNB IF output impedance and the related cables. The Printer (3) is provided to make screen copies.

This arrangement provides for the common use of precisely the same hardware system for all three DBS and NP signal measurements, so that the relative signal comparisons are valid.

The Receiver System is comprised of the following components:

a. DBS Antenna / LNB (15) -- RCA/ DSA100RW – 18 in. dish.

b. Splitter (24) -- True-Spec HFS-2P/2150
Operating Freq.: 0.9-2.15 GHz.

c. Northpoint IRD (17) -- Tandberg TT1200 IRD.

d. DirecTV IRD (20) –	RCA/ DRD303RA.
e. Echostar IRD (22) –	ES Dish /Model 3000.
f. Spectrum Analyzer (25) –	HP8591E w/ HPIB control I/O.
g. Printer (3) –	HP Think-Jet w/ HPIB port and cable.
h. Cables (16, 26, 27) –	RG-6/SAT/Foam – F(M) (75 ohm) (16) – 75 ft. long. (26, 27) – 5 ft. long.

B. Setup and Calibration

How the Transmitter Was Set Up

The NP Transmitter (NP-Tx) was installed on the Franklin Building at 111 Congress Avenue, at the intersection of 1st Street and Congress Avenue in Austin, Texas. The transmitter antenna was mounted on the 25th floor balcony, outside the DCE offices, on the west side and near the SW corner of the building. The antenna height was 270 ft. AGL.

Due to the particular nature of the required mounting arrangements, the presence of the building corner to the east side of the antenna is known to introduce some amount of asymmetry in the transmitted signal pattern, including some blockage of service area to the east. However, this effect is not expected to be great enough to be of concern for the purpose at hand.

The antenna tilt angle was set to 0 degrees (pointing in horizontal plane). The E - polarization was set to the horizontal plane. For this orientation, the 3 dB beam width in the horizontal plane is 110 degrees. The NP-Tx antenna pointing direction was nominally south.

Finally, the NP-Tx output power was calibrated to 5 dBm with a resulting EIRP of 12.5

dBmi. The transmitter was operated with a carrier frequency of 12.470 GHz and modulated to produce a symmetrical modulation bandwidth of 8 MHz (See Section C (1) for carrier frequency criterion).

How the DBS and Northpoint Signals Were Received

A mobile field test system was implemented, containing the DBS Receiver System (DBS) and the Test Set System (TS) and other related equipment. The system was comprised as follows: An instrument van was outfitted with an instrument work-station arrangement. A towable hydraulic boom lift device was used as an antenna platform and towed with the instrument van. A Honda motor-generator of 2500 W capacity was mounted on the boom lift carriage and used to power all of the equipment.

For the antenna mount, a wooden platform, 8 in. wide by 4.5 ft. long, was mounted on the starboard side and top of the lift basket, with the long dimension parallel to the vehicle axis. The DBS antenna was mounted on the aft side of the platform, and the TS antenna was mounted on the forward side, so that the antennas were about 4 feet apart. The LNA and associated power supply were also mounted on the platform in a metal box. Electrical power was supplied to the platform via a 120 volt cord.

The RF signal cables, (10) for the TS System and (26) for the DBS Receiver System, were routed along the lift boom from the antenna platform into the van, and signals Po and Px, respectively were observed in the van.

The lift basket could be operated such that the antenna platform could range in height from 4 ft. to 33 ft. AGL. A human operator was normally employed at the antenna platform, and radio walkie-talkies with vox headset were used for communication between the platform and the van.

The DBS and Horn antennas were each mounted on mechanical pan/tilt mechanisms suitable for pointing in any direction. Vehicle orientation was arranged to avoid physical pointing conflicts between the antennas.

Maintaining Calibration

The DBS Receiver System was calibrated to relate the measured signal Px, at the Spectrum Analyzer, to the equivalent output of an isotropic receiving antenna at the same site. Thus, a 'Gain over Isotropic' is determined for the DBS system.

The DBS calibration was done by using the precision TS System as a standard. The respective system output signals Px and Po were determined with the adjacent antennas both pointing to the NP transmitter and receiving the same transmitter signal. The known TS System gain is defined as ao = Po / Psi, where Psi is the isotropic reference signal, while the DBS System gain to be determined is defined as ax = Px / Psi. The unknown DBS System gain can thus be determined as ax = ao * (Px / Po). In decibel form, the gain expression is:

$$ax(dB) = ao(dB) + (Px(dBm) - Po(dBm)), \text{ where } ao(dB) = +42 \text{ dB}.$$

From calibration data obtained at Site 1 on 12/22/98 (See Appendix 2), the DBS System 'Gain over Isotropic' is determined to be:

$$ax(dB) = +77.9 \text{ dB}.$$

The equivalent isotropic signal Psi from measurements with the DBS System can then be determined from the measured Px value as:

$$Psi(dBmi) = Px(dBm) - ax(dB) = Px(dBm) - 77.9 \text{ dB}.$$

Knowledge of the theoretical equivalent aperture of the isotropic antenna, one can determine the received signal in terms of spatial power density units if desired.

C. Measurements

DBS Channelization

To determine a suitable NP-Tx operating frequency and test site-monitoring criterion, it was necessary to establish the frequency range for specified DBS transponders and to determine some particular TV channels related to the specified transponder. During the early field work, experimental tests were done by injecting an adjustable carrier signal from the Synthesizer into the DBS antenna and tuning this signal until observed transponders and TV channels were affected. Suitable channel/transponder information was determined and later confirmed by the DBS providers. The following parameters apply to the test project:

DBS	Transponder (Tsp)	TV Channel
DirecTV	T18	226
Echostar	T18	301

NP-Tx Carrier Frequency -- 12.470 GHz (near Tsp T18 center freq.)

The NP-Tx was operated throughout the tests with the prescribed carrier frequency. Any interference from the NP signal would affect transponder #18 for either DBS service. The indicated TV channels were monitored to observe the received signal integrity. Although other known TV channels are related to the same transponder, all related channels are affected if any one is; thus, only one channel needed to be monitored.

DBS, Northpoint and Test Set Signal Measurements

Because of the relatively low sensitivity of the precision TS System, its purpose in this project was relegated to calibration of the DBS System in areas of fairly strong signal level. Thus, it was used as a calibration standard, and not as a normal measuring tool. The DBS and NP signals (3 signals) were routinely measured at each and all sites with the DBS System. The hardware was thus precisely the same for all three measurements, such that ratio comparisons of the signals were valid even without knowledge of the absolute gain of the DBS System. However, the calibrated absolute system gain was used to determine the absolute signal values with the Isotropic Reference.

The DBS output signal level Px was measured for each of the 3 signals by the SA and recorded as the basic data, without any scaling applied; and conversions to other units were done later. For each of the DBS and NP signals, a hardcopy page of the spectral plot was recorded and the spectrum value at the NP-Tx carrier frequency was also read and recorded by use of the SA marker (MKR) feature to provide a digital readout at the set MKR frequency. A 'Trace Average' was normally done prior to recording the data. A standardized set of SA processing and display parameters was established and used on all plots and data for a particular type signal.

Power Density Spectrum – Units: (power / 1MHz):

The SA Resolution Band Width (RBW) was standardized at 1 MHz for all readings. Thus all of the basic field data is recorded with that resolution band, and the SA spectral plots can be interpreted as frequency power density functions with the effective units of 'power per 1 MHz frequency increment' (e.g. A multiplier of 1e-06 would be required to convert the function to the normal density units of 'power / Hz'.).

Total Power in Modulation Band – Units: (power):

An alternate representation of the signal power was also produced in the data reduction process. In this case, the SA power density reading was used to produce an estimate of the total power present in a specified bandwidth. For the DBS signals, transponder #18 was assumed to be 24 MHz wide in frequency, and the total power in that modulation band was computed by multiplying the basic Px power density reading by 24. Likewise, for the NP signal, the modulation bandwidth was taken as 8 MHz, and the total signal power was computed as Px * 8. These computations of total signal power tacitly assume that the signal power density is constant across the band used, and this is considered to be a reasonably good assumption for this data. For the data in decibel units, these conversions are done as follows, where Px is the power density and $\underline{Px}$ is the total signal power in the modulation band:

Total Signal Power from SA Reading Px:

DBS Signal: <u>Px (dB)</u>= Px(dB) +(10 * log (24)) = Px(dB) + 13.80 dB

NP Signal: <u>Px (dB)</u>= Px(dB) +(10 * log (8)) = Px(dB) + 9.03 dB

DBS Signal Strength Pointer (ssp)

Both DirecTV and Echostar provide a software generated 'signal strength pointer' for use in adjusting the DBS antenna axis to peak the signal during the initial setup process. The pointer operates on a scale of 0 – 100 and appears to behave similarly to a signal strength meter as the antenna is pointed. During the early part of this field work, DirecTV personnel provided some information on the general nature of the ssp behavior, indicating that it is driven by signal error rate and might be used as a qualitative measure of same. The ssp is supposedly a function of the inverse error rate, such that it increases to a high value as the error rate decreases, and conversely. A concise expression of the ssp relation to error rate has not been made available.

Field experiments were conducted which seem to confirm the ssp relation to error rate. In one test, at Site 3, which is near the point of maximum NP interference conditions for DirecTV, the ssp values were seen to increase slightly in correspondence with physically shielding the NP signal from the DBS antenna. The ssp values were also seen to rise and fall slightly as the NP signal was turned off and on. Subsequent similar tests confirmed the same behavior. In an alternate test, an RF interference signal was injected into the DBS antenna with a Synthesizer and small antenna probe, after the DBS antenna had been peaked on the satellite. The ssp value could be made to vary from 0 to the high 90's by adjusting the magnitude of the interfering signal. It was observed that a related TV picture continued to remain OK until the ssp value was reduced to 10 or less on the 0-100 scale. This suggests that for the ssp scale, the error rate is tolerated by the system for ssp values over most of the displayed range of 0 – 100. It is further observed that setup instructions for DBS consumer systems normally specify a pointer value of 60, or so, as the lower threshold for a suitable antenna setup.

Similar experiments conducted on the Echostar DBS system indicates a similar behavior in the ssp implemented by Echostar. Thus, it became apparent that the ssp value would be a useful parameter to monitor and record during the field tests.

Method for ssp Field Observation

An obvious test approach would be to observe the ssp values with the NP-Tx signal both off and on. While this was done for some early tests, it was found that similar results could be obtained by leaving the NP-Tx on and comparing the ssp values for transponder

T18 with other even numbered transponders that were away from the NP frequency band and not affected by NP. For the ssp recording scheme employed in the survey data reported herein, a sampled array of 10 ssp readings for each of transponders T16, T18, T20 is recorded, with values read at approximately 1 second intervals. The average value for each set of 10 is used as the effective pointer value. An appropriate log sheet was prepared for this data, and the readings by this scheme were done on all sites surveyed for both DBS satellites.

Further Reduction of The ssp Index Data:

In order to provide a straightforward index number to portray the ssp pointer depression behavior, the average ssp values from the field logs were reduced as follows:

Reference ssp value -- sspo = (ssp(T16) +ssp(T20))/2

Pointer Depression Index -- pdix = ssp(T18) / sspo

The pdix value decreases with depression of the ssp values for T18, the target transponder.

IV. Test Procedure and Results

A. Overview

Testing Was Done at 30 Sites Representing A Wide Variety of Conditions

The tests reported herein were conducted with the equipment, calibration, and measurement considerations as described in Section III, except as specifically noted otherwise. The field data was acquired from the 22nd through the 31st of December 1998. Tests were done at a total of 30 sites, located as shown in the site maps of Figure II-1 and Figure II-2 and the table of Figure IV-3. The near range site locations are also illustrated in the aerial photo presentations of Figure IV-P1 through IV-P6.

A routine set of tests was conducted at each of the 30 sites in order to determine the related signal strengths, the information integrity of the various signals, and the extent of any DBS interference by the Northpoint signal. The tests were done by a uniform set of procedures and the results provide a useful database of the said information for a reasonable sampling of the survey area.

In addition to the routine tests, efforts were also focused on various points of special consideration, such as Mitigation Zone issues, effects of signal reflections and multi-path conditions, and NP service area range and reception issues. Such special considerations also influenced the site placement, and in some cases, additional observations are made and recorded.

At Each Site a Uniform Series of Measurements Were Taken

Routine Test Data

The NP Transmitter was turned on continuously during the test work each day and operated under the constant conditions as described in Section III, with the transmitter carrier frequency f_T = 12.470 GHz and EIRP P_T = 12.5 dBmi. At each test site, the following tests and procedures were done:

(0) For Calibration only – otherwise omit:
Point the Test Set (TS) Horn antenna to NP-Tx and acquire NP signal;
Record power spectrum plot (SA screen copy);
Record power density value Po at the NP-Tx frequency f_T;

(1) Point DBS antenna to NP-Tx and acquire NP signal;
Peak NP signal with SA reading; Note TV signal quality;
Record power spectrum plot (SA screen copy);
Record power density value Px at the NP Transmitter frequency f_T;

(2) Point DBS antenna to DirecTV satellite and acquire signal;
Peak the DBS signal with the antenna pointing facility provided, peak ssp;
Monitor Transponder T18 and TV chan. No. 226; Note TV signal quality;
Record power spectrum plot (SA screen copy);
Record power density value Px at the LNB IF frequency - 1.22 GHz;
Record ssp sample values (10 each) for each transponder T16, T18, T20;

(3) Point DBS antenna to Echostar satellite and acquire signal;
Peak the DBS signal with the antenna pointing facility provided, peak ssp;
Monitor Transponder T18 and TV chan. No. 301; Note TV signal quality;
Record power spectrum plot (SA screen copy);
Record power density value Px at the LNB IF frequency - 1.22 GHz;
Record ssp sample values (10 each) for each transponder T16, T18, T20;

Antenna Platform: For the above tests, the antenna platform was operated with the lift boom down, for a platform height of 4 ft. AGL, except for cases where an elevated platform was needed to acquire the NP-Tx signal. This information is logged.

Site Maps: Site map sketches were prepared for each site, providing details of position and orientation with respect to local landmarks. Weather conditions are noted either in this or another part of the log.

GPS Fix: A Garmin GPS12 receiver was used to provided site coordinates which were recorded on the Site Map log page, together with other position information available.

Each Site is Extensively Documented

The field sites are identified by assigned site numbers, and descriptive site names are also assigned as a reference aid.

For reference, a complete set of field logs is included in the Appendix 3 of this report. The logs include site maps, data logs, and all SA screen copies.

Figure IV-1 and Figure IV-2 show sample signal power spectra (SA screen plots) from Site 1. The plots include the DBS, NP, and TS signal spectra. The field data and certain results are summarized in the tables of Figure IV-4, Figure IV-5, and Figure IV-6, with data reduction as discussed in the Measurements discussion of Section III.C.

Basic Field Data

Figure IV-4 provides a summary of the numerical field data, weather conditions, and date and time of testing for each site vs. site number. The DBS and NP power spectrum values Px are tabulated together with the TV picture status and the antenna platform height. The average ssp index values are listed for each of the two DBS satellites for transponders T16, T18, and T20. Abbreviations for DirecTV (DTV) and Echostar (ES) are used for the data tables and other parts of the report and are used extensively in the logs.

Reduced Field Data

Figure IV-5 and Figure IV-6 list the DBS and NP signal powers after conversion to the Isotropic reference. Figure IV-5 shows the power spectral density in dBmi for 1MHz, and Figure IV-6 shows the total signal power in the modulation band in dBmi. NP-DBS margins for each of DirecTV and Echostar are also given for each case; and finally, the ssp-derived values sspo and pdix, discussed in Section III.C, are listed together with both forms of the signal power.

Signal Power Units:

DBS and NP signal strengths are presented here in both power spectral density and in total power units to enable signal comparisons in both forms. When considering the prospect of NP-DBS interference, it is probably more pertinent to use the total signal power values when considering signal thresholds and the like. However, it is also useful to consider the signal power density comparisons for some conditions. The prospect of interference by a given signal depends on the nature of the process being affected. And in general, the threshold criteria related to interference might need to include both density and total power in the specification.

Not A Single Case of DBS Signal Failure Observed

For the tests conducted at 30 sites and reported herein, test site conditions varied widely. Some site positions were very near the NP transmitter and occupied regions within the predicted Mitigation Zones; some environmental circumstances were highly conducive to signal reflections and multi-path conditions; and the weather conditions included rain and heavy overcast skies during some test periods. Yet, there was not a single case of DBS signal failure observed throughout the tests. And while evidence of increased signal error rate was indicated by the ssp data for 3 or so close range sites, the error rate influence appeared to be small, since the worst case pointer depression index (pdix) was 0.83.

The ssp pointer depression index (pdix) appears to show some slight depression for most of the near range sites inside a radial distance of 0.6 miles or so, where the NP signal is relatively strong. Whereas, for sites with increasing radial range from the NP-Tx, the pdix values reach values of 0.97 to 0.98 and above and remain that way for more distant sites. This transition to higher pdix values appears to be at a distance of less than a mile. It should be noted here that even in the worst case example, the ssp value did not fall below the suggested minimum signal strength.

An experiment to test the effectiveness of shielding was conducted close in to the NP transmitter. The test was conducted by using a small aluminum plate to shield the DBS antenna feed horn assembly from the NP signal and demonstrated that interference in this near range zone is easily reduced to near zero (pdix near 1.0). It is also evident that the interference is largely due to a condition where the DBS antenna feed horn LNB input is directly exposed to the NP signal, i.e. not blocked by either the dish or its orientation. The interference of this nature is easily remedied with minimal shielding as was shown or by selecting an antenna design without an offset focal point assembly.

In summary, the NP interference influence occurs only at close range sites, as theoretically expected, and appears to be small even there. The presence of the NP signal did not affect the ability to receive the DBS signals at any site during this test project. If situations occur where interference becomes a problem, it could be easily remedied by either a small and simple shield assembly or by replacing the receive antenna with an antenna of a different design. No such remedies were needed for any sites of this test project.

There were no interference complaints by DBS consumers during this test project, although several DBS systems were known to exist within the Mitigation Zone.

B. Close Range and Mitigation Zone Areas

Great Attention Was Paid To the Areas Closest To The Northpoint Transmitter

The region of greatest interest during the test was the area closest to the transmitter. It is this region where the Northpoint signal is the strongest and therefore is the area that has the greatest theoretical risk of interference to the DBS signal.

Numerous sites were tested in close proximity to the NP transmitter, in order to examine the interference issues related to the stronger NP signal and the prospects for reflections and multi-path conditions due to the presence of large buildings and other structures. Of the near range sites tested, the ones of concern here are Sites 1, 3, 4, 5, 6, 7, 8, 9, and 10, located south of the river from the NP transmitter. These site locations are shown in the Figure II-2 Site Map, and they are also identified in the aerial photos, Figures IV-P1, P2, P3, and P4.

Field Data Confirmed Theoretical Predictions

These sites show a small depression in the ssp values (decreased pdix), except for Sites 5, 6, 8, and 10, all of which show a decreased level of NP signal strength. For Sites 5, 6, and 8, the NP transmitter is obstructed by buildings, causing a smaller signal; and Site 10 is both further away and is positioned such that the NP signal passes through a dense grove of trees. Thus, the data makes sense in terms of the theoretical expectations. The NP influence is relatively small in every case, as judged by the ssp data and the fact that the DBS signal integrity is good at all sites. At no time did the NP signal cause the ssp of the DBS receiver to fall below the suggested value of 60.

One issue of primary importance in the tests is the nature of two maximum interference potential (MIP) regions that were identified by the DeLawder study (referenced earlier), one for each of the two related DBS services. Site 3 was placed in the MIP region for DirecTV and Site 4 was placed in the MIP region for Echostar. All signals were of good integrity at both sites, with no apparent problems. Some depression could be observed in the ssp values, as expected. The following table suggests a correlation with the theoretical MIP zones:

Pointer Depression Index Values (pdix)

Site	DirecTV	Echostar
3	0.83	0.99
4	0.93	0.91

In both cases, the NP effect is small, and did not impact the ability to receive a good quality signal.

Good DBS Signal Integrity Observed Close to Northpoint Transmitter

Site 1 (Hyatt) has the strongest NP received signal level of all sites as expected since it is closest to the transmitter. It shows a pdix value of 0.85 for DirecTV, which indicates less NP influence than for Site 3. This result is as predicted since Site 1 is not located within the DirecTV MIP, while Site 3 is.

Site 20 was placed in a position such that the NP-Tx antenna was completely hidden by buildings, yet a usable NP signal was obtained, while no interference was observed at all. In this case, the NP signal was acquired from building reflections in the vicinity of the NP-Tx, a mechanism that can be positive and useful for NP reception in downtown areas.

Of the four sites placed to the NW of the NP transmitter, there was no significant indication of error rate influence by NP on the DBS signals, while at the same time, a useable NP signal was acquired.

From most of these near range sites, reflections could be observed from surrounding buildings and other structures. No ill effects appeared to arise from any of the reflections.

Some special experiments on this topic will be discussed in Section C.

In summary regarding the near range sites, the various behaviors were as predicted. Evidence of NP-DBS error rate influence is apparently small and if interference were to affect a close-in user it can be essentially eliminated by simple measures.

C. Multi-path and Reflection Tests

Some special experiments were conducted in the near range site region to examine the nature and possible influence of NP signal reflections from buildings and other structures in the site vicinity. Sites used are again Sites 1, 3, 4, 5, 6, 7, 8, 9, and 10. These sites are shown in Figure II-2 and the same aerial photo figures as listed earlier, and Photo 1 of Figure IV-P1 is of particular focus in this discussion.

Although one or more reflections were observed at most of the near range sites by intentionally scanning with the DBS antenna, they were usually small and there was no observed negative influence that could be attributed to them. It was desired to identify some reflection conditions that were more severe and that could be considered close to worst case in the area.

drive the instrument van slowly to the NW across the Palmer parking lot (along the yellow line in Photo 1), while an operator continuously scanned for any possible reflections. In doing this, the antenna operator scanned especially for reflections from Palmer Auditorium and from all surrounding buildings. Nothing of significance was found in this test.

No Negative Impact on Northpoint Signals from Multi-Path Effects

It was then decided to seek possible reflections from specific buildings by strictly geometric predictions of where they would be and position the test site to observe them. This turned out to be relatively easy for the buildings to the south of the Palmer parking lot, because the north faces contained glass panes in which the NP transmitter site could be seen when standing in the appropriate ray path. Test sites 7, 8, 9, and 10 were established in optimal places from which to get a NP reflection from these two buildings. For reference, the reflection buildings are the City of Austin Electric Dept. (COA), just south of Sites 7 and 8, and the office building 811 Barton Springs Road – (OB811), just south of Site 9. Site 7 receives a reflection from the north face of the east wing of the COA building, and Site 7 is positioned to receive a reflection from the large glass covered central portion of the north building face, through trees at the front of the building. Site 9 is positioned for a reflection from OB811, east wing, through trees, and Site 6 is aligned for a reflection from the west wing of OB811, with a greater reflecting surface available.

Full site data acquisition was done at each of these sites, and in addition, the reflection data was observed and recorded, and a spectral plot (SA screen copy) was obtained. Associated reflection spectral plots are included in the Receiver Site Logs with the associated site data.

The following table summarizes the reflection data observed for these four sites, where Px(N) is for the direct path reading, and Px(R) is for the reflection path:

Site No.	Px(N)	Px(R)	Px(N)-Px(R) dBm	Comments
7	-34.6	-41.3	+ 6.7	Brick and Glass.
8	-58.2	-52.6	- 5.6	NP behind Palmer.
9	-38.8	-53.3	+14.3	Ant 15' AGL - better Px(N)
9A	-59.4	-46.1	-13.3	Ant 4' AGL
6	-53.7	-57.6	+ 3.9	NP obstructed.

In Photo 1, one can visually tract the reflection paths and the other geometrical aspects of the problem, including the nature of the NP direct path, as well.

Clearly, in two of these cases, the reflected signal was larger than the NP direct signal. A perfectly good NP TV signal was of course found to be available via the reflection, as well as for the direct NP signal in all cases.

DBS Not Hurt by Northpoint Multi-Path Signals

As an important observation in this test, there was no discernible evidence of any ill influence due to the strong reflections to either the DBS signals or the NP signal.

A similar test was later conducted at Site 10 on the TXDOT parking lot, also visible in Photo 1. In this case, the NP reflection is from the north face of the building, which is about 50 to 70 percent glass. The direct NP signal is seen through a fairly dense grove of trees along the north side of the parking lot. The readings are as follows:

	Px(N)	Px(R)	Px(N)-Px(R) dBm
Site 10	-61.3	-52.2	-9.1

The reflected signal is larger in this case, too. The DBS and NP signals were good, and there was no detectable negative influence from the reflection.

As another pertinent observation, the large reflections in these tests were all directed toward the front side of the DBS antennas (although not along the bore sight), and there was no ill effect seen. From the test experiences, it appears to be likely that the reflected signals of significant energy are normally fairly well defined (as opposed to highly diffuse and scattered), and there is only a very small probability that a reflected signal of importance would enter the DBS antenna from an angle within the main beam. If it did, then only small changes in the DBS antenna placement would likely solve the problem. It is suggested that the multi-reflected and scattered signals that might be more prevalent in the propagation angle are usually very attenuated and not likely to be of importance. It is recognized that there could be exceptions to this described condition, but none were found during this test. From the experiences in this project thus far, the exceptions are likely to be rare.

D. Tree Obstruction Tests

Sites 11 and 12 were placed for the purpose of investigating the NP reception in areas where trees are prevalent. These sites are shown on the Site Map of Figure II-2, and the Site 12 is also shown in the aerial photo 6 of Figure IV-P6. The area is a wooded residential neighborhood located to the south by a mile or so. For ground to rooftop heights, the NP signal is seen through trees in many places. For these test sites, the DBS antenna (receiving NP) was optimally positioned to receive the NP signal through the trees. The NP and DBS signals were all good.